The Worst Thing Since Sliced Bread: The Chorleywood Bread Process

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Abstract: In the 1950s, Britain's local bakers were under siege. Large, highly automated bread factories could supply bread at a lower price, finding a ready market in the growing supermarket presence on the high street. The small bakers turned to the British Baking Industries Research Association (BBIRA), based in Chorleywood, outside London. After very few years of research, the bread scientists unveiled a method that took less time and was able to use lower-protein home-grown wheat: the Chorleywood Bread Process. If the high street bakers thought they were saved, they were sorely mistaken. The big industrial bakers adopted the same process and, helped by their size and the growth of the supermarkets, ate the bakers' lunch.

In this paper, I will look briefly at the history of large-scale bread-baking. Since the 1960s, bread making has changed from a largely biological process, albeit with mechanical input, into a more inert process that depends on chemicals and motors. These changes have been widely blamed for bad health and societal ills, possibly without foundation. Finally, the spread of Chorleywood bread also prompted the renaissance of the artisan baker, but she is not the high street baker of old. Those of us who are willing to pay the price might now be getting the bread we deserve, but traps for the unwary remain.

The Chorleywood Bread Process (CBP), a method developed in the UK that took less time and was able to use home grown wheat of lower protein, represents perhaps the greatest change in the technology of bread-baking in the past 14,000 years. More than 80% of the bread baked in the UK and Ireland is made in this way, and the process has spread to Africa, Asia, Australasia and South America. While North America has large-scale and rapid bread-making processes of its own, the CBP has ironically not made inroads there because the problem it solves – reducing the amount of high-protein North American wheats in the flour – is not a problem on the North American continent.

The CBP starts with 2 to 5 minutes of very energetic mixing of the ingredients: flour, water, salt, yeast and a variety of dough improvers; at a minimum ascorbic acid and a hard fat. Immediately after mixing, the dough is divided into portions representing the final loaves. It moves on a conveyor for about 8 minutes before being shaped, during which some fermentation takes place, with double the amount of yeast in a conventional loaf making up for the reduced time. After shaping, the dough may go into a tin, where it proves in a controlled environment for a further 45 to 50 minutes. It is then baked for 17 to 25 minutes before being cooled for about 2 hours. The loaves are then sliced and wrapped. The entire process takes around 3 to 3.5 hours from start to finish.

By comparison, a traditionally produced commercial loaf could easily take 5 to 6 hours, while an artisanal loaf from a small craft-bakery might take 24 hours or more, although during that time nothing much need happen in the way of human activity.

Origins of the CBP

The CBP is named for the town of Chorleywood outside London, which was the headquarters of the British Baking Industries Research Association (BBIRA), established in 1946 as one of a wide range of research associations designed to serve specific industries and funded by subscriptions from the industry, matched pound for pound by the UK government. The BBIRA's mission was to carry out generic research of value to British bakers.

In the early 1950s, most UK bread was produced in many hundreds, if not thousands, of small, generally family-owned bakeries. The traditional bread-making process included a period of bulk-fermentation, after the dough had been mixed, that lasted around three hours and that gave the yeast time to leaven the dough. As the 1950s progressed, the Weston Company of Canada was importing large quantities of Canadian wheat for its growing chain of bakeries in the UK. The point about Canadian wheat is that it contains higher levels of crucial proteins, gliadins and glutenins. Together, these form the gluten network that traps the carbon dioxide produced by the yeast, allowing the bread to rise. Stronger, high-protein wheat produces a greater volume of bread than the same quantity of weaker wheat. Despite the cost of transportation, Canadian wheat, along with larger bakeries, allowed the Weston bakeries to produce cheaper bread.

In response, millers in the UK started to buy up and consolidate smaller bakeries to protect their sales of flour. However, the millers still needed to add a fair bit of high protein imported wheat to their grist to enable their bakeries to compete with bread from Weston bakeries.

By the late 1950s, small bakeries were suffering and turned to George Elton, a new Director of Research appointed in 1958, to help them compete with cheaper bread from large baking plants. The original focus was on continuous mixing of the dough to save time. BBIRA researchers were aware of no-time, continuous mixing processes in the USA, notably Do-Maker and Amflow, in

which the dough ingredients are fed continuously into one end of the mixer, at the other end of which dough emerges. Such continuous mixers, however, were not available in the UK and in any case the bread they produced proved unacceptable to British consumers. Pursuing a continuous process to begin with, the BBIRA scientists took small samples of conventionally mixed dough and, at small scale and in the laboratory, gave it a bit of extra mixing.

That extra mixing enabled them to almost completely do away with the period of bulk fermentation. The quality of the resulting bread 'as defined by bread volume, softness and cell structure' was as good as, and often better, than that produced by a slower mix with time for a bulk fermentation (Cauvain and Young, 2006, p. 8). The BBIRA performed around 30 experiments a day and quickly determined that the final quality of the bread depended almost entirely on the amount of work put into the dough. The optimum proved to be about 11 watt-hours (Wh, a measure of energy) per kg of dough.

By early 1961, BBIRA researchers had the details more or less perfected and had designed and commissioned a new kind of mixer. After agonising briefly over the name, the BBIRA published its findings in July 1961 as BBIRA Report No. 59. The researchers took their show on the road, loading the mixer into a van, driving around the UK, and over the course of a little more than a year demonstrating the process to more than 1000 bakers with all sorts of different ovens. Many of the bakers were suitably impressed, not least Lord Rank, chair of the Rank Hovis Group, which owned one of the larger industrial bakeries, British Bakeries. In late 1964 the BBIRA demonstrated the CBP in one of the august Conversaziones and Receptions of the Royal Society, which noted that '[b]y the intense application of a fixed quantity of mechanical energy to the dough the period of bulk dough fermentation can be reduced from three hours to a few minutes.' (Anon., 1964. Publishing the report and demonstrating the process prevented the BBIRA from patenting its invention and receiving any royalties.) Crowning its achievements, the BBIRA received the Queen's Award to Industry 'for technological innovation in breadmaking processes' in April 1966, the first year of the awards.

Why does the CBP work?

Bread vies with beer for being the oldest biological transformation process that people make use of. The changes that take place as flour, water and leavening (and salt, please) turn into bread are many and complex, but the formation of the gluten network is fundamental. Flour contains two sorts of proteins, glutenins and gliadins. In dry flour, each of these forms a tightly coiled molecule. As the flour absorbs water, the molecules are able to uncoil and to bond together. Mechanical work, for example as you push the dough under your palms while you knead, straightens out the molecules and opens up more places for them to form these bonds, which are called disulphide bridges. At a microscopic scale, the expansion caused by bubbles of carbon dioxide inflating as a result of the yeast working also stretches the gluten and allows extra bonds to form, one reason why a period of bulk fermentation strengthens the dough.

Stretching the gluten, to allow more bonds to form, first means that existing bonds must be broken. Mechanical work helps to break those bonds, which is why the extremely vigorous mixing that is the hallmark of the CBP delivers a strong dough in very little time. But there is also the question of the bonds reforming along the whole length of the stretched-out molecules. This requires a chemical process called oxidation. One of the more important so-called flour improvers, which was vital to the development of the CBP, is the powerful oxidising agent potassium bromate, which not only bleaches flour very white but also strengthens the dough.

The EU banned the use of potassium bromate in 1990 because it is a carcinogen, although it is still permitted in the US on the grounds that baking converts it all to a harmless form. Anticipating the ban, researchers began to investigate other chemicals. One is ascorbic acid (vitamin C), which works in a slightly different way to build stronger links between the gluten molecules. Another common improver is L-cysteine, an amino acid that also helps disulphide bridges to break and reform. Another vital addition in the CBP is some sort of fat, especially one that is at least partially solid at the temperature in the mixer. The fat probably lubricates the gluten network as the fibres slide over one another, making the dough much more extensible and the loaf that much airier. Fats also help to slow staling, keeping the crumb softer for longer. One of the most used fats is partially hydrated palm oil but, like potassium bromate, although for different reasons, the hunt is on for alternatives.

After the ban on potassium bromate, attention also turned to enzymes that speed up processes taking place naturally in the dough. Amylases, for example, break down starches into sugars, on which the yeast feeds. Flour naturally contains amylases, but bakers can now add specifically formulated amylases that work more rapidly to produce lots of sugar for the yeast. Proteases are enzymes that break down proteins, which increases water absorption and also releases amino acids. These react with glucose in the Maillard reaction, which produces the colour of the crust and extra flavours.

Effects of the CBP

One of the most immediate effects of the CBP was to sharply accelerate the closure of smaller bakeries. Although it had originally been small bakeries that were the foundation of the BBIRA, and the target for the development of the CBP, consolidation in the industry overtook the small bakeries. In the event the CBP, which is

capital intensive, was more suited to larger establishments and was rapidly taken up by them.

Reliable figures are hard to come by, but it is very clear that the number of independent bakers in the UK fell from the 1950s. In terms of sales by volume, the Federation of Bakers estimates that large bakers now account for 85% of sales and in-store bakeries 12%, with just 3% for high-street bakers, many of which are themselves using versions of the CBP (Federation of Bakers, n.d.). The Federation itself offers an insight into the baking industry; it consists of 9 member companies which operate 34 bakeries that manufacture mainly sliced and wrapped bread. One Allied Bakeries plant in Stevenage produces 1.8 million loaves a week. That seems like a large number, 'enough bread to fill five Olympic-sized swimming pools,' but in context, Britons eat (or buy?) the equivalent of 9 million loaves a day. Allied's nine similar plants thus probably supply less than a third of the UK market (McEvoy, 2015).

The CBP did also solve the problem of wheat imports. Millers were able to reduce the amount of Canadian wheat they were importing, which fell from 2.5 million tonnes in the early 1960s to 300,000 tonnes today. The CBP was estimated to have saved £45 million in the 20 years after its introduction. Indeed, the CBP allows loaves of bread to be made from extremely low-quality wheat, the only problem being that the finished loaves jam the slicing machines 'with a sticky mass of degraded starch that can only be removed with a pickaxe' (Edwards, 2007, p 174). It somewhat changed the entire wheat economy of Europe, reducing imports of Canadian wheat and boosting a process called wheat washing, which extracts vital wheat gluten that can then be added to weaker flours (Leuck 1990). Farmers, especially in the UK, were offered a premium by millers to grow wheat varieties more suitable for bread making and breeders were encouraged to select for the baking quality of the grain rather than just the quantity, which is almost all that matters if the wheat is being fed to livestock.

Staying with the bread, however, brings us squarely into the highly contested area of what constitutes a 'good' loaf of bread. There is no doubt that the modern industrial loaf suits the vast majority of UK consumers. Further, the modern industrial loaf includes more than the familiar wrapped and sliced loaf. The dough produced by the CBP can be moulded into many shapes. The pressure and composition of the gas above the dough in the mixer can be manipulated to produce a crumb that is fine and uniform, as in a sandwich loaf, or coarse and open, as in a bloomer or baguette. Crusts, likewise, can be adjusted to suit the kind of loaf, and much of the 'interesting' bread on sale in supermarkets and bakeries remains the product of the Chorleywood and similar bread-making processes. For all that bread purists may object, according to Stanley Cauvain and Linda Young, who were both closely involved in the development of the CBP, 'the advent of the CBP went largely unremarked by the British public. Perhaps this was because the introduction of the CBP left UK bread quality relatively unchanged' (Cauvian and Young, 2006, p13).

What, then, constitutes 'bread quality'?

A good loaf

Obviously, the quality of a loaf depends on what we expect from that particular kind of bread. A wrapped slice that has a hard crust is stale, but so too is a baguette that has a soft crust.

The Director of Research of the BBIRA put it this way:

> The process gives bread which is better in respect of volume, texture, colour and keeping qualities and is indistinguishable in flavour from bread baked from the conventional three-hour fermentation process (Elton 1969, p 322).

For the most part, industrial bakers stay with physical characteristics that are relatively easy to measure, rather than the deeply suspect opinions of people who eat bread. Indeed, advocates of the CBP concede only that flavour is reduced 'in some views' and say that these detractors have no 'real understanding of the processes by which bread flavour is developed'. They go on to agree that flavour development is 'undoubtedly linked with the length of bulk fermentation time' and to suggest that '[i]f increased flavour is required [...] then the use of a sponge or flour brew is recommended' (Cauvain and Young 1999, p 36).

This is the crux of the matter. Bakers can improve the flavour of breads produced by the CPB but that would increase the time and complexity of the process and so they don't. The vast bulk of shoppers apparently does not want tastier bread, so the demand isn't there either. The overwhelming consideration driving the original development of the CBP and its further refinement has always been economic. As George Elton, Research Director of the BBIRA, put it immediately after praising the 'volume, texture, colour and keeping qualities' of CBP loaves, '[i]t also increases the yield of bread from flour by about 4 per cent' (Elton 1969).

The CBP's primary effect was to lower the price of a loaf of bread. Consumers who want (or need) only to pay less for their bread may welcome that, but it has unavoidable effects. As one book wryly puts it:

> The Chorleywood process is chosen by bakeries that decide to make the cheapest possible bread. This sort of product has not enhanced the reputation of the product (Edwards, 2007, p 174).

The rise of the artisan

Perversely, however, the rise of the CBP and other no-time dough processes fuelled the demand for precisely the type of bread it replaced, where time rather than energy and hands as well as machines make the dough. As with the decline of small bakeries after the introduction of the CBP,

there are no reliable data on the more recent growth in artisan bakeries, although campaigners and others say it has been considerable. Many of these bakeries and a growing number of home-bakers are using freshly milled whole grain flour, which offers superior nutrition and taste. Operations range from a chain that bakes hand-made loaves at each of around 50 outlets in and around London, to individual 'micro-bakers' who might bake to order once or twice a week and deliver by bicycle. Sourdough loaves, produced by long fermentation with a starter based on yeasts and bacteria gathered from the wild, are particularly favoured as the process not only develops complex flavours and textures but is also said to make the bread more digestible. Costs are considerably higher, but enough customers are willing to pay. This contrasts with supermarket loaves, which have seen a 12% decline in sales over the past five years, and a squeeze on the big bread factory companies, one of which may well have to close over the next few years (Butler 2017).

Factory bakers and supermarkets offer further indirect evidence of the rise of artisan breads, by promoting products labelled artisan and sourdough. These terms have no legal definition, and suppliers of industrial flour improvers and small companies beloved of home-bakers alike, sell bags of sourdough flavour 2–3% of which will convert an ordinary loaf into a sourdough loaf. Most recently, a group of five baking trade bodies drew up a 'UK Baking Industry Code of Practice for the Labelling of Sourdough Bread and Rolls' and sent it to the UK Department for Environment, Food and Rural Affairs, which regulates food standards. '[W]here space and skills are lacking' the code permits the use of processing aids, pure yeast and other leavening agents 'that help to simplify the process'. The use of pure yeast and sourdough flavour undermines any perceived value of the term 'sourdough' as it is generally understood (All quotations from Morrison 2019).

Health

In my opinion, too much has already been written about the part that rapid bread-processing technologies may or may not play in the rise of self-diagnosed gluten intolerance. My personal opinion is that there may be something to the various arguments that put the blame on insufficient fermentation, and I know of individuals who say they can eat long-fermented breads with no ill-effects, while supermarket bread causes them distress. The matter is definitely not settled and, again personally, I doubt that it ever will be to anyone's complete satisfaction.

Conclusion

The CBP and other no-time dough-making processes undoubtedly disrupted bread and baking in much of the world. The CBP also represents something of an anomaly in industrial innovation. Many other manufacturing processes have changed from being based largely on physical and chemical processes to take advantage of the efficiency of biological processes, for example the use of enzymes to catalyse chemical syntheses that otherwise require considerable heat and pressure. Bread-making has gone in the opposite direction, substituting mechanical energy and chemistry for the biological processes (and time) that create well-developed dough that bakes into high-quality bread.

There have been gains and losses. The CBP enables the bulk production of a dietary staple at considerably reduced cost, a clear benefit to consumers and shareholders. It also hastened the demise of smaller, independent bakeries and caused macro-level shifts in overall economic activity. More recently, no-time dough processes have driven the growth of artisan bakers who are producing loaves that by any standard other than simple economic cost are of far higher quality than any bread of the past. In the developed world, at least, people in future should be able to eat the bread they want.

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